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ABSTRACT

The authors illustrate the application of a systems approach for educational decision-makers through utilization of a special education systems simulation model with emphasis on teacher training. It is noted that the model provides a procedure to answer "what if" type questions before actually implementing a proposed program. Discussed are the implications of such variables as legislative intent, certification guidelines, and funding sources; and considered is the impact of these variables on teacher training (and upon each other). (IM)

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A SPECIAL EDUCATION SYSTEMS SIMULATION MODEL:

TEACHER TRAINING EMPHASIS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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ABSTRACT

Many definitions of the "systems approach" begin with problem indentification and progress through a definition of objectives, consideration of alternative approaches to accomplish the objectives, and choice among alternatives. However, the fact remains that systems analysis is not a set of well developed techniques which generally provide a quick and easy answer to the problems of choice among educational or health related problems. One must carefully devise each system component to fit into a desired area of application. The development of a Special Education Systems Simulation Model has been initiated with this thought kept in mind. Emphasis is placed within the domain of teacher training. The key to the application of this model is the focus of interest on decision-makers and the provision of a procedure whereby they are able to ask and receive answers to "what if" types of questions before actually implementing a program. Many difficult to control variables such as legislative intent; certification guidelines; federal, state and other regulatory and funding sources may have direct implication on teacher training. An assessment through planned simulation of the impact of these variables on teacher training, as well as the impact of these variables upon each other can, on a cost-reasonable basis and procedurally sound format, provide those decision-makers responsible with appropriate and essential knowledge of teacher training implications prior to actually having to assume direct responsibility for the consequences. Decision-makers with teacher training concerns can utilize the Special Education Systems Simulation Model; however, equally applicable is the model as interest is focused within the domains of Administrative Sub-system simulation and Child Study Sub-system simulation.

INTRODUCTION

Much has been written about the "systems approach", specifically illustrating the application of its techniques. The "systems approach" originated during World War II when many individuals from a variety of backgrounds were thrown into the war effort and asked to help solve defense planning problems. Often, their solutions to these problems were original and unique, albeit quite different from what professional defense analysts themselves could originate. The primary reason for such divergence is implied - the rigor of scientific inquiry had been brought to bear upon operational problems that had previously been solved by relatively arbitrary approaches.

Many accounts of the systems approach begin with problem identification and progress through objectives, consideration of alternative approaches to accomplish the objectives, and choice among alternatives (Yee, 1973; Smith, 1971; Jones and Sommers, 1975). In a broad sense, the systems approach is regarded as a point of view which involves taking into account the "arena" of problem solving activity from beginning to end.

However, within the systems domain a plethora of flexibility for application exists. That is, "systems analysis" does not provide unequivocal techniques leading to quick and easy answers to questions regarding the best alternatives for approaching education or health related problems. Instead, one must carefully devise for each unique situation, a system component to appropriately fit into a desired area of application. In the present article, an attempt is made to illustrate a systems approach for education decision-makers by using a special education systems simulation model with emphasis on teacher training.

Why a simulation approach? Because a simulation model is used in place of the real system it can rapidly and inexpensively give useful information about the dynamic, that is, time-varying, behavior of the real system that the model represents (Forrester, 1968). A simulation model permits decision-makers to receive answers to "what if" questions. For example, "What if we implement a mandatory service law?" or "What if we cut back on teacher training funds by $3 million?" Answers to these questions address the processes occurring in the system and the simulation may reveal:

a. in order to provide teachers to appropriately staff positions for service to handicapped children, a specific amount of funding will be required for inservice or pre-service training.

b. a minimum of a 3 year lag will occur in order to provide sufficient staff for positions mandated by law.

c. institutionalized children will not receive complete services unless additional required funds are provided for specific programs.

d. the current funding pattern is regressive, in that the local school districts cannot afford to increase programs and services at the required rate.

Further, such information is provided in the context of other on-going processes in the system. The Special Education Simulation Systems' output is, therefore, information upon which decision-makers can decide on the optimal of alternative decisions which affect services to handicapped children.

Special Education Systems Simulation

The Special Education Systems Simulation Model has three major sub-systems. The Administrative Sub-system, Child Study Sub-system, and Teacher Training Sub-system.

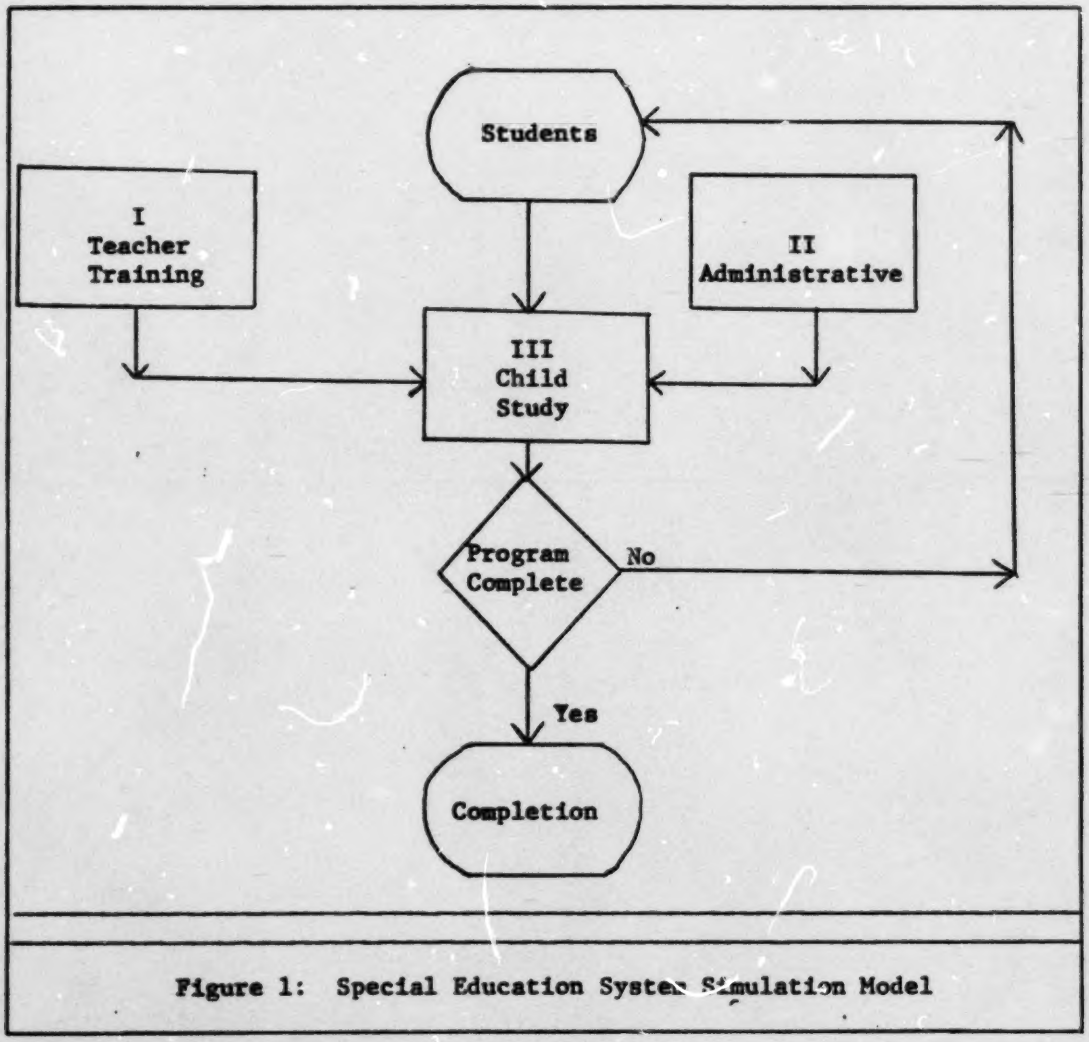

Figure 1: Special Education System Simulation Model

In this model the Administrative Sub-system provided the potential of simulating problems in finance. Questions may be asked of this system such as, "What if we write a policy converting from a 70% program reimbursement to a Full Time Equivalency reimbursement formula (e.g. Florida)?" The Child Study Sub-system provides the potential of analyzing the relationship between handicapping condition, treatment (methods) and acquisition of objectives (outcome), and other possible variables such as pupil/teacher ratio, mainstreaming, teaming, etc. (Jones, 1975). Using multi-variant techniques and large state or national populations, trends may be indicated which would normally go unnoticed and the validity of methods may be explored with higher than average levels of confidence (Sommers, 1973, Sommers and Joiner, 1970).

Crucial to the most appropriate introduction of the Special Education System Simulation Model is the Teacher Training Sub-system. The remainder of this paper will address in detail this Sub-system. Primary impact of the simulation model on the Teacher Training Sub-system would be evidenced by:

1) a decrease in the lag time for the development of trained staff.
2) a decrease in the amount of cost in training by choosing the most cost-effective method of training and the most appropriate trainees (preservice, inservice, retrained, etc.).
3) an increase in the training of skill areas most necessary, earliest in the retraining/inservice training process.
4) the selection of courses and methods of training which would assure a partially trained teacher maximum continued contact with the teacher's handicapped students during training.
5) the indication of additional areas of impact on teacher training and child service as a result of developing the conceptual model (the development of the model is expected to increase the number of known

impact areas as a result of discovering here-to-fore unrecognized relationships).

Decision-makers can use data within the teacher training simulation model for:

1) identifying variables which must be considered when formulating legislation, guidelines, budgets, and other policy level actions. The effect of such policy level activities on teacher training and the services of handicapped children may be considered only when the independent variables involved have been identified (Jones, Sommers and Joiner, 1976).
2) predicting of the effect of policy changes on teacher training. These effects can occur within wide but useful parameters if the variables are not only identified but verified and their inter-relation defined. Planners might then find greater reliability in forecasting the impact of, for example, mandating the main-streaming of handicapped children or changing special education funding from pupil units to program reimbursement.
3) predicting the effect of policy changes on every part of the teacher training system and, therefore, the creation of viable policies. Precision in the complex educational milieu is possible only through computer simulation of possible policy changes.

Figure 2 illustrates a conceptual model of operations for the teacher training sub-system. The flows are represented by lines and arrows and levels or processes by squares. Rates or values are represented by the rectangle/triangle and the terminals or sinks by ovals. Quantities which flow through the system are students and time.

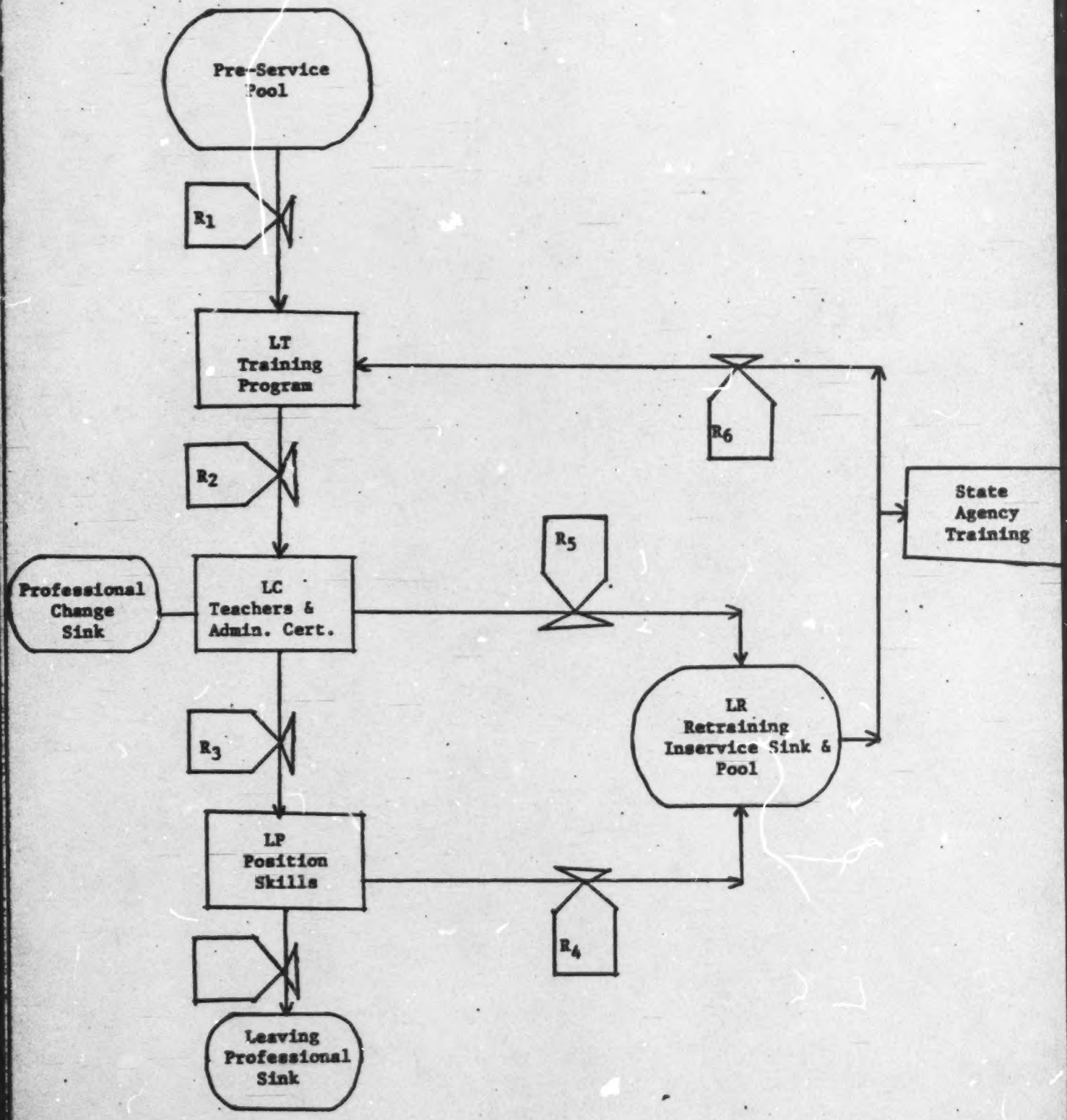

Figure 2: TEACHER TRAINING SUB-SYSTEM SIMULATION MODEL

The mathematical and, therefore, computer basis of this model is found in the definition of each level. Mathematically, a level exists only as a function of the rate of flow in and the rate of flow out.

That is: $LT.K = LT.J + DT\ (R_1.JK - R_2.JK)$

(adapted from Pugh, 1970)

or

Level "T" now is equal to (level "T" at time 1) plus the elapsed time (rate of change).

and

The rate of change is equal to (Rate 1 - Rate 2) $\frac{\cdot}{\cdot}$ (time interval).

Simply, the size of each level or process is the function of the rate of flow in + the rate of flow out.

Model Development

When developing a tentative model, the first step is to extend the study of the teacher training processes to confirm the validity of the model or revise the model. The second step is to define the variables which affect the flow. Table I contains some examples of flow variables and illustrates a prediction of those variables which might control the rate of flow from one level to another and was developed from studies of federal, state and other issues.

Step 3 in the development of the simulation model is the emperical analysis of the validity of the variables included. Each variable must be designated as having a reasonable probability of affecting the rate of flow and affecting variables around it. Step 4 is the investigation of the affect of one variable upon another. Step 5 is the programming phase at which time those variables which can be quantified are entered into a computer based program which is run on available data for each variable. Each level is first tested separately then in connection with subsequent levels. The last step

TABLE I

Teacher Training Variables

Rate (R_1) Variables

- Space Available
- Admission Requirements
- Prerequisites
- Application Procedures
- Selection Procedures
- Final Selection
- Evaluation Procedures

Rate (R_2) Variables

- Federal Funding Patterns
- Certification Requirements
- State Laws & Rules
- Financial Aides
- Intelligence Requirements
- Credit hours
- Course Outline
- Educational Procedures

Rate (R_3) Variable

- Skill Requirements
- Position Openings
- Evaluation Procedure
- Legislation
- Manpower Implications
- Job Market
- Civil Rights Act
- Emergency Government

Rate (R_4) Variables

- Renewal Requirements
- Program Approval Changes
- R & D Findings
- Civil Rights Act
- Community Political Desires
- Evaluation Procedures
- Advanced Standing
- Seniority
- Legislation

Rate (R_5) Variables

- Nearness to Certification
- Certification in higher need areas
- Employment Training Act
- Habilitation
- National & State Budget
- Rehabilitation

Rate (R_6) Variables

Similar to R_1 with feedback from pre-service pool
Manpower Training and Retraining Act
(Other possibilities that you may wish to consider)

is to run data through the completed system and correct programming problems.

Careful note should be taken of the fact that simulation models may be highly useful long before the completion of Step 6. As a conceptual model, with listed variables, a manual describing its components should be of great value to administrative decision-makers and planners as issues are discussed which relate to teacher training. A completed computerized model would, of course, offer a great deal of depth and flexibility in the planners' ability to investigate alternative policies programs.

SUMMARY

The definition of any system is very flexible. The definition chosen for a specific systems analysis should be one which, in light of the information available, appears most useful to that analysis and the policy-making guidelines which are available. A primary criteria for the selection of a systems approach would be one which takes into account all components which can be effectively dealt with by the decision-makers of the discipline for which the analysis is being performed.

An attempt has been made in this presentation to illustrate the application of a systems approach for educational decision-makers through utilization of a special education systems simulation model with emphasis on teacher training. As illustrated, the model provides decision-makers with a procedure to answer "what if" type questions before actually implementing a proposed program in the teacher training domain. Many "difficult-to-control" variables (i.e. legislative intent, certification guidelines, federal, state and other funding sources) may have direct implication on teacher training. But an assessment, through planned simulation, of the impact of these variables on teacher training as well as the impact of these variables upon each other can, on a cost-reasonable basis and procedurally sound format, provide decision-makers with appropriate and essential knowledge of teacher training implications prior to actually having to assume direct responsibility for the consequences.

Decision-makers with teacher training concerns can find immediate applications for the Special Education Systems Simulation Model. The primary intent of sub-system simulation development is to provide decision-makers with reserve understanding of appropriate program implementation approaches, facilitating their decision-making roles, and handling day-to-day issues within a systems format.

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